**A.P Calculus Name\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Date\_\_\_\_\_\_\_\_\_\_\_\_**

**Intro Problems #1**

**For these problems, please show all calculations that lead to your answers and include units with all answers!!**

1. *Pendulum Problem:* A pendulum hangs from the ceiling. As the pendulum, swings, its distance, *d* cm, from one wall of the room depends on the number of seconds, *t*, since it was in motion. Assume that the equation for *d* as a function of *t* is: , . It is desired to find out how fast the pendulum is moving at a given instant, *t*, and whether it is approaching or going away from the wall.

a. Find *d* when *t* = 5. If you don’t get 95 for the answer, make sure your calculator is in radian mode.

b. Estimate the instantaneous rate of change of *d* at *t* = 5 by finding the average rates for *t* = 5 to *t* = 5.1, then for *t* = 5 to *t* = 5.01, and then for *t* = 5 to *t* = 5.001. Compute the average rates on the intervals given, then, provide an estimate for the instantaneous rate based on those average rates.

c. Why can’t the actual instantaneous rate of change of *d* with respect to *t* be calculated using the method in part b?

d. Using a technique similar to that in part b, estimate the instantaneous rate of change of *d* with respect to *t* at *t* = 1.5. Show the time intervals that you used to compute **three** average rates of change. At that time is the pendulum approaching the wall or going away from it? Explain.

e. How is the instantaneous rate of change related to the average rates? What name is given to the instantaneous rate of change?

f. What is the reason for the domain restriction ? Can you think of any reason that there would be an *upper* bound to the domain?

2. *Board Price Problem:* If you check the prices of various lengths of lumber, you will find that a board twice as long as another of the same type does not necessarily cost twice as much. Let *x* be the number of feet long a 2” by 6” board is and let *y* be the number of cents you pay for the board. Assume that *y* is given by:

1. Find the price of 2” by 6” boards that are 5 ft long, 10 ft long, and 20 ft long.
2. Find the average rate of change of the price in cents per foot for 5 ft to 5.1 ft, and then from 5 ft to 5.01 ft, and then from 5 ft to 5.001 ft.
3. The average number of cents per foot in part b is approaching an *integer* as the change in *x* gets smaller and smaller. What integer? What is the name given to this rate if change?
4. Estimate the instantaneous rate of change in price if *x* is 10 ft and if *x* is 20 ft. Show the time intervals that you used to compute the average rates of change. You should find that each of these rates approaches an integer.
5. One of the principles of marketing is that when you buy in larger quantities, you usually pay less per unit. Explain how the numbers in this problem show that this principle does *no*t apply to buying longer boards. Think of a reason *why* it does not apply.